THE NECESSITY FOR EARLY CORRECTION IN CONGENITAL CLUB-FOOT.[1]

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GENTLEMEN: The cases brought before you this morning are of considerable interest, and I would like to have you try to place yourselves in the position, in which, as medical men, you must be placed when called upon to decide how to correct similar deformity, at what age it should be done, how long your efforts at correction should be continued, and what will be the condition of the feet in after life.

The first patient, aged three months, is one with equino-varus, that was sent here by a graduate of the school. In the first place let us observe the position of the foot; it is the typical position of equino-varus, for the reason that there is present a compound variety of talipes. The inversion, or turning in, is very pronounced; if the patient could walk it would do so upon the outer side of the foot. There is equinus, because the heel would not touch the ground in walking. Both of these conditions being present in the same foot requires for its description a name which will designate the presence of the compound variety, and therefore it is called equino-varus. The question now arises as to the degree of severity of the condition in this case, to determine the character of the remedial measures to be employed. By gentle pressure I can completely overcome the varus, but I am unable to overcome the equinus. The tendo-achilles, or the gastrocnemius muscle is shortened, hence this difficulty. The articulating facet of the astragalus is dislocated from the natural position in contact with

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the tibia, and is decidedly prominent upon the outside of the foot, and the astragalus itself is undoubtedly malformed. Here, then, is the case before you; now the question arises, What shall be done, and how soon shall the treatment be started? Let us consider the arguments on both sides as to the earliest moment that correction would be advisable, and with that object in view, let us take as a basis the period at which the centers of ossification appear in the tarsal bones. That of the astragalus shows itself at the seventh month of fœtal life, and it is the astragalus that in the large majority of cases of congenital club-foot is the principle, although not the only, disturbing factor. The os-calsis has two centers of ossification; one of which appears at the same time as that of the astragalus—the seventh month; and the second, that for the great tuberosity, appears at the tenth year. The center for the scaphoid appears at the fourth year; for the cuboid, at birth; and for the three cuneiform bones, between the first and third years. If these bones of the tarsus are in a deformed position at birth, what is the condition of the bones themselves at this time? Are they ossified or cartilaginous? All the bones of the tarsus are in a cartilaginous state at birth; the centers of ossification of the astragalus and os-calsis only having appeared prior to this time, and that of the cuboid has just appeared. Accepting this, it would seem that the rational course to pursue, would be to correct the deformity at the earliest possible moment, so that the process of ossification may go on in the proper manner, with the bones of the foot held in correct position, and it is therefore important to decide when that earliest possible moment is. Many surgeons urge that no case should be operated upon until the child is old enough to walk, at one or one and a half years. If we wait until then, however, we must know what the condition of the bones of the feet will be at that time. With the exception of the

cuneiform bones, all have shown centers of ossification before that time, and the ossification has progressed in the deformed position in which they are held by any contracted soft tissues. This dry specimen shows a double congenital equino-varus in a still-born fœtus, showing the malposition of all the tarsal bones. If these bones had ossified in the position in which they now are, this process would have gone on while they were in a deformed position, and as a result, at the age of one or one and a half years, if we should divide the tendons, the effect would be to simply rearrange deformed bones, the period having elapsed when it was possible to materially alter their shape. I contend that it is not rational to wait until the doubtful assistance of walking can be secured, because I believe that it is clearly proven that the earliest moment at which you correct the deformed foot, the more satisfactory will be the ultimate result. This ultimate result, however, depends upon the completeness of the first correction, and as well, upon the efficiency of the maintenance of the corrected position and the establishment of correlation of muscular forces. Relapses are the inevitable result of inefficiency on the part of those having the care or direction of the institution of remedial measures, and one of the prominent factors in these cases, I have found to be incomplete early correction.

The incompleteness of the early correction depended, in some instances, upon the late period at which correction was attempted, for I am abundantly satisfied that the best ultimate results I have had, have been in cases where complete correction was accomplished in the first month, and persistent efforts maintained. In many of these cases I have found an entire absence of those signs of muscle atrophy which are so conspicuous in, I believe I am right in saying, neglected cases. Now, shall we take a child at the age of one month, or less, and divide the tendons or other con-

tracted soft tissues, or shall we confine our efforts entirely to manipulation and the employment restraining apparatus until a later period in the child's life? I know that there are those who advocate postponing operation until a later period, since in some cases manipulation alone will apparently elongate the contracted tendons. While it is improper to say that in all cases operative procedure should be resorted to, I firmly believe that the rule should be adopted, and, without exception, that complete correction should be accomplished at the earliest possible moment, and that this correction should be accomplished by the employment of every rational means, let it be operative, mechanical, manipulative, or gymnastic, but it must be complete to be effective.

I believe that the soft bones of the tarsus will alter their shapes as they are squeezed and compressed by force, and leave the shortened tendons as much contracted as they were before, because we know that tendons rarely, if ever, yield, except by tearing, while cartilaginous bones, not yet ossified, will yield to pressure. I believe that you will find, on making an examination of such a foot, no elongation of the tendons, but an altered external appearance of the foot, due to the softened condition of the bones, their being squeezed into an external appearance of correction. I believe, therefore, that at the earliest possible moment we should employ any method which will be necessary to correct the deformity, and which will prevent a return to the deformed condition. It is a very unusual thing to have the opportunity of making a post-mortem examination in the age of early infancy, in a condition of congenital club-foot, whether it has had proper, or improper, attempts at partial or complete correction. I am inclined to believe that the malformation of the tarsal bones, seen in adult specimens, is often produced by the character of the manipulative force that was applied in early

infancy, and that this would not have occurred had complete division of contracted soft tissues been made at the proper time.

I told you earlier in the course, that it was necessary, for convenience of study, to divide your cases of club-foot into three arbitrary divisions: the first variety including those in which the deformity is easily corrected, and the foot easily maintained in the correct position; the second variety is that in which the deformity can be corrected, but with difficulty, and immediately returns upon cessation of restraining force; and the third variety is that in which it is impossible to correct the deformity without recourse to surgical or powerful mechanical measures. This second child has one foot in a mild form of equino-varus. You will notice how easily the deformity can be corrected, and how easily it is maintained in the correct position. There are no contracted tendons in this case, and it has been impossible to find diminished activity in any muscle. The displacement of the tarsal bones is slight, especially of the astragalus, and this is easily effaced. Here it would be markedly improper to perform any surgical operation, for there is nothing to operate upon, no contracted soft tissues to cut.

The child I had before you first affords an illustration of the third variety in which the varus only could be overcome, the equinus not yielding, and I bring her before you again to emphasize another point. Shall we proceed, by force alone, to try to overcome the deformity? I have already explained the disadvantages of such a procedure, and will demonstrate the procedure that I consider essential. This morning I shall proceed to divide the tendo achilles, for the reason that that is one factor in the foot which maintains the deformity and prevents a correction. The patient comes from a distance, and the parents wish us to perform the operation and send the child

home at once. I shall operate, however, and keep the child for a week, and then demand that the child be brought to us every two weeks, to enable us to keep an oversight of the case. This is an ordinary experience, for it is curiously deemed a trivial thing to correct a club-foot in a baby, and that simple division of the tendo achilles is the cure. In reality, the first correction, no matter by what means accomplished, is but means to an end. It is not only correcting the appearance of the deformity, but it is the correction of the mechanical defect so that the mechanical functions may be re-established.

The successful accomplishment of a cure of club-foot depends upon the efficiency of all three legs of a tripod, as it were, correction, maintenance of the correct position, and the establishment of correlation of muscular forces. And upon the tripod depends the efficiency of the treatment. I always insist that the patients, after the primary operation, shall come under my observation again at a period of not over one month, and that not more than a month shall elapse without a critical inspection, that the progress may be watched, to avoid neglect. If plaster of Paris is left on for any considerable length of time, an atrophy of the muscles of the leg must necessarily follow from disuse. The muscles in these congenital cases are usually perfectly normal at birth, but are induced to become atrophied by the means resorted to, to overcome the deformity. After taking the plaster of Paris off, we shall, in this case apply an apparatus permitting full free motion of the ankle, but holding the foot in natural position. I shall also instruct the mother how to manipulate the foot, so as to prevent atrophy of the muscles, by encouraging muscular development. The production of muscular atrophy, which is such a serious obstacle to correction of club-foot after infancy, is a profoundly interesting subject, and I have but to refer you to Chinese ladies' feet for

evidence of what is too often done with club feet. The long continued use of plaster of Paris, or mechanical apparatus of any kind that does not provide free ankle motion, will accomplish, just as successfully as the binder, a muscle atrophy. This muscle atrophy is, in turn, followed by atrophy of bones, not only in their diameter, but in their length as well. The natural tendency of a congenital club-foot is towards atrophy from disuse, and, therefore, we are warranted in resorting to every means to avoid its occurrence.

If the plantar fascia in this case is so tight or contracted as to hold the foot in the incorrect position, we shall divide that, in addition to the achilles. The same thing holds true with reference to the flexors of the toes, if I find them unduly shortened. In brief, divide with a clean cut all soft tissues that restrain perfect correction, for unless you do this, you are sure to have an incomplete correction. In performing the operation, I put the foot first into a stretched position and then mark with my thumb nail a point sufficiently far from the tendon, say one-fourth of an inch, where I insert my knife. The point at which the division of the tendon-achilles is preferably made, is just above the attachment of the tendon to the os calsis. It is simply a matter of choice whether I cut from within, outward, or from without inward. You can now see the degree of separation of the two ends of the tendon. There is a space here of fully three-quarters of an inch, which permits of elongation of the tendon to that extent. I apply collodion over the wound, to hermetically seal it, to prevent any contact with the atmosphere and septic germs, and therein lies the advantage of the subcutaneous method, namely the avoidance of the risk of suppuration. Notwithstanding the greatest care, however, there is always danger of infection taking place, no matter whether an open wound is made or the operation is done subcutane-

ously. The subcutaneous method has the least risk, in that only a minute puncture is made, with immediate closure of the wound. I always prefer the open method, for it is far more skilful and accurate, and avoids the necessity of cutting other tissues than the tendon to be divided.

The length of time required for a tendon to unite, is from one to two weeks, and at the end of three weeks the new formed structure is as strong as any other part of the tendon. Immediately after tenotomy the foot should be placed in an over-corrected position, so as to separate the divided ends of the tendon as much as may be required, depending upon muscle contraction to shorten it when necessary. The method of putting the foot into the deformed position, or in only a partially corrected position, should not be observed, because it will be necessary to stretch something later, or re-divide the tendon. To stretch this newly formed tissue is to weaken it by making it attenuated. I believe I have never known a tendon to fail to unite, although great separation of the divided end has, in some cases, taken place.

Now the question arises in the application of our maintenance apparatus of plaster of Paris, what is the object to be accomplished by its use? In the first place, to mould the foot into a proper position and force the tarsal bones to occupy positions approaching the normal. The foot is now in an over-corrected position, being extended to less than a right angle and slightly everted, and the plaster of Paris will hold it in this position. In about two weeks the tendon will be strongly united, and enable us to begin our manipulation. Then will be the time to apply our steel maintenance apparatus, and it must be prescribed with a definite object. That object is, I am sure, now clear to you, and I will therefore indicate its essential features. A free ankle joint, obtained by having that part which is attached to the

sole of the shoe, joined to the upright lateral leg bars, at a point above the tip of the malleolus. Just below the knee a semi circular band holds the upright bars in proper position, and is strapped and buckled in front. There must be nothing, whatever, to prevent free motion of the ankle in the natural hinge motion. It is often expedient to use elastic traction as a means of maintenance, and where this is sufficient and is desired, it can easily be accomplished with the use of elastic rubber bands, held in place by adhesive plaster. I never like to leave the plaster of Paris on longer than three weeks altogether, because its use is not beneficial, and its long continuance sure to be prejudicial. The child being under ether, I have no hesitancy in using as great force as may be necessary to overcorrect the foot.

There is danger to be avoided in the use of plaster of Paris, to which I must direct your attention, for it has occurred, or been threatened sufficiently often, to be a warning of the possibility of its occurrence. I refer to the possibility of constriction and strangulation, and the possible production of gangrene. There need be no fear of this if you carefully instruct the mother to frequently observe the condition of the circulation, by pressing upon the toes, and observing if the pink flush follows the white appearance produced by the finger. To make this possible you must, of course, leave the toes uncovered, and it should be a rule never to cover an entire extremity, because you want to know what is going on there. Should the mother notice any apparent interference with the circulation, she can call your attention to it, and you can, if necessary, remove the cast and reapply it. Plaster of Paris always contracts in setting, and a knowledge of this will prevent the application being made too tight.

The length of time required to accomplish a full and complete correction of a congenital club-foot is

the same as that required to form the foot of a normal child. Not until a child is ten or twelve years old does a foot possess the normal mechanical conditions necessary for its full usefulness. All babies are flat-footed, many are naturally pigeon-toed, but all of these conditions pass off where there is a natural tendency to do so.

The same thing may be said of a child born with a club-foot, certainly in the milder forms, that until the age of ten or twelve years, the correction must be maintained mechanically, and efforts must constantly be made to develop the muscular system.

That which in the normal child prevents the foot from becoming deformed, although it may be placed temporarily in a deformed position, is the correlation of muscular forces, and this must and can be established in cases of club-foot that are corrected sufficiently early. You must avoid the absurdity of resorting to gymnastic forms of treatment, and at the same time destroying its efficiency, by the use of mechanical restraining apparatus, that not only prevents the reproduction of the deformity, but at the same time restrains all motion. Thus I have seen rigid plaster of Paris in constant use in cases where it was removed every day for half an hour, and during that time, development methods employed. To accomplish a complete recovery, there must be an understanding of the mechanical functions to be recovered, and this is apparently absent in those who simply cut tendons and allow the case to relapse by neglect, or who consider braces to be curative.